Choosing Catheter Shapes for Radial PCI

Considerations for selecting the right tool when using transradial access for percutaneous coronary intervention.

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The device industry has been able to design nearly perfect hardware to cannulate the coronary ostia while working via the femoral access route. Unfortunately, this is not yet true for the radial route, although several experienced radialists have designed diagnostic and guide catheters with a variety of curves. Although the skills used in femoral procedures will serve you well, transradial procedures present some new challenges, including issues in the radial, subclavian, and aortic arch regions.[1-5] To gain better insight, an operator needs to have a thorough understanding of the differences in the anatomies and catheter courses for the transfemoral approach (TFA) versus the transradial approach (TRA).[1]

UNDERSTANDING THE CATHETER'S COURSE: TRA VERSUS TFA

With TFA, it does not matter whether the right or the left femoral artery is used for coronary cannulation, but with TRA, there are subtle differences between the right and the left approaches, as shown in Figure 1. These six drawings depict the course of the catheter via the TFA and the TRA (right and left). You can see the sites of resistances in the passage of catheters and guidewires through these approaches. These sites of resistance explain the different maneuvers needed to cannulate the coronary arteries, which allow the operator to torque and steer catheters and guidewires through the various angles of the arterial system.

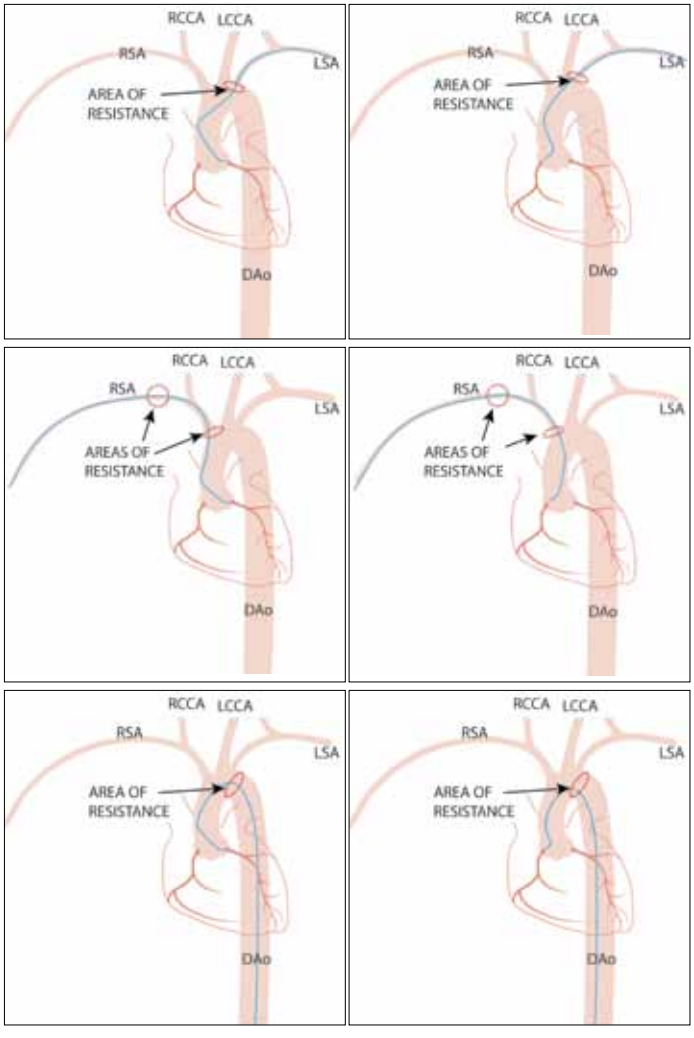

Figure 1. Understanding the catheter's course: radial versus femoral.

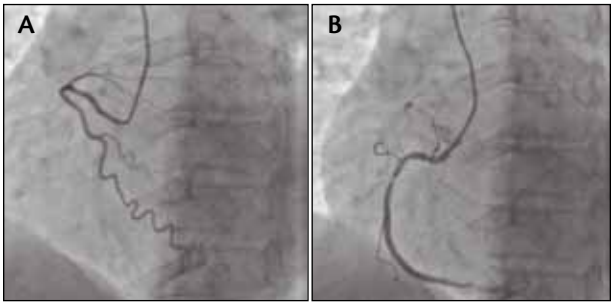

Figure 2. When attempting selective RCA cannulation, the catheter selectively cannulated the conal artery (A). The stiff end of a standard 0.035-inch guidewire was moved near the primary curve of the catheter to successfully cannulate the RCA (B).

HAND-EYE COORDINATION

For TFA and the left TRA, there is only one level of resistance that affects the behavior of the catheter. For the right TRA, there are two levels of resistance. In routine cases without any significant tortuosities of the subclavian artery and no dilatation and/or distortion of the arch, torque may not be a major issue, and the operator should be able to cannulate the coronary ostia without much effort. However, hand-eye coordination is very useful if there is significant dilation, distortion, and/or tortuosity at the subclavian level, leading to loops at the arch level or while working through the difficult anatomy of arteria lusoria.[1-3] This means that rather than being fussy about whether to perform a clockwise or counterclockwise rotation, the operator should simply look at the screen and direct catheter-manipulating hand movements to advance the catheter's tip toward the coronary ostia.

CHOOSING CATHETER SHAPES FOR CORONARY CANNULATION

For transradial diagnostic catheterization, a 5-F Optitorque TIG catheter (Terumo Interventional Systems, Inc., Somerset, NJ) is our first choice, because it cannulates both left and right coronary arteries, and left ventriculography is also possible because it has an additional side hole. Moreover, it has advantages over left and right Judkins curves because multiple catheter exchanges are not required. The major limitation of the Optitorque TIG curve is its lack of backup support, and for this reason, it does not make a good guide catheter shape for intervention. In rare situations, such as anomalous origins of coronary ostia, we use different catheters for diagnostic cannulation, including the Amplatz curve and multipurpose curve, among others.

Although, various guide catheters are being used by different operators for percutaneous coronary intervention (PCI), the EBU (Medtronic, Inc., Minneapolis, MN), XB (Cordis Corporation, Bridgewater, NJ), and Voda (Boston Scientific Corporation, Natick, MA) catheters are our top choices for left coronary cannulation, and a Judkins right (JR) or Patel-Pancholy (Pa-Pa) curve (Medtronic, Inc.) are the preferred curves for right coronary cannulation in our lab. In selected situations, we use an Amplatz left (AL) or right (AR) curve or a multipurpose curve. Examples of commonly used guide catheters include EBU, XB, Voda, Judkins left (JL), AL, Pa-Pa, JR, and Ikari left and right (Terumo Interventional Systems, Inc.).

CHOOSING A GUIDE CATHETER SHAPE SELECTION FOR TR PCI

For left coronary cannulation, always start with an extra backup curve (EBU, Voda, or XB), particularly for long- or medium-length left main coronary arteries (LMCAs). For short LMCAs, it may be necessary to change strategy and start with a JL curve. For right coronary cannulation, always start with a JR curve. A Pa-Pa curve is also a good option. For a downward takeoff of the right coronary artery (RCA), a multipurpose (MP-1) curve is suitable. For a shepherd's hook origin of the RCA, an internal mammary artery (IMA) or an AL guide catheter should be used.

If there is significant tortuosity in the subclavian region, or if there are loops due to dilatation and/or distortion of aorta (or if there is arteria lusoria), the normal torque of the catheter is not preserved. Hence, hand-eye coordination is very important. Rather than using wrist movements to adjust the torque of the catheter (regularly practiced when using the TFA), use finger movements to cannulate the coronary ostia when using the TRA.

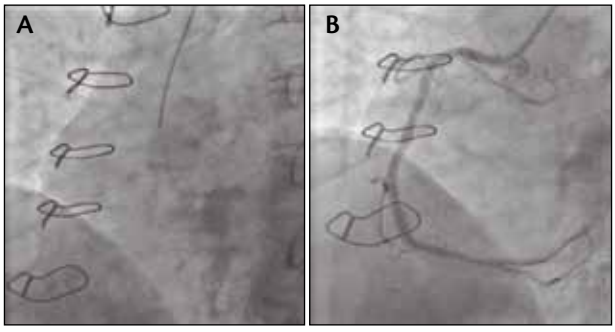

Figure 3. After completion of LAD intervention, a 6-F JL 3.5 guide catheter was disengaged from the LMCA ostium, and the stiff end of a 0.035-inch standard guidewire was negotiated to transform this catheter into a JR curve (A). Successful cannulation of the RCA ostium was performed in the usual fashion (B).

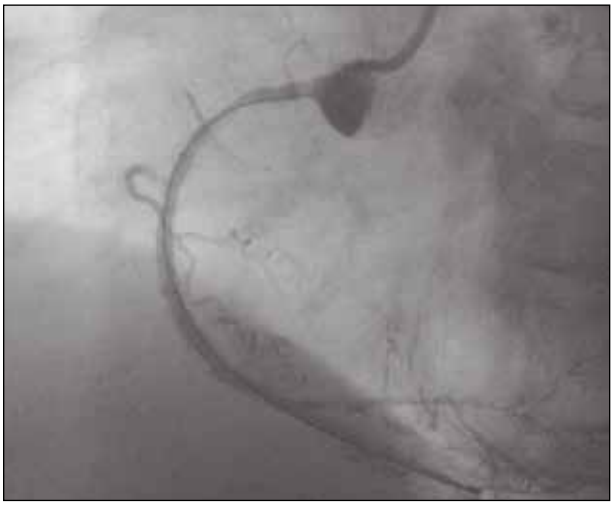

Figure 4. Aortic dissection in the right coronary cusp was created by the tip of a 6-F AL 1 guide catheter.

DEALING WITH UNIQUE AND CHALLENGING SITUATIONS

At times while engaging the RCA ostium via the right or left TRA, a 5- or 6-F JR guide catheter has a tendency to selectively cannulate the conal artery (although it is more of a problem with a 5-F TIG Optitorque catheter). Conal artery cannulation is identified by a damping of the aortic pressure tracing. In this situation, the catheter should be immediately disengaged, and a second attempt should be made to engage the RCA ostium. If this problem repeats, the following maneuvers can be attempted. Take a 0.032- or 0.035-inch J-tipped guidewire and introduce the straight (stiff) end through the catheter lumen. Bring it up to the primary curve of the catheter without letting it protrude outside the tip. Try to engage the RCA ostium in the regular fashion. This maneuver is successful in most instances (Figure 2).

At times, a JR guide catheter does not provide adequate backup support for intervention of the RCA. In such situations, a JL 3.5 or JL 4 guide catheter can be tried. It should be carefully rotated in the same fashion to cannulate the RCA ostium. The stiff end of a 0.032- or 0.035-inch standard guidewire may also be used with the same technique, described previously, to cannulate the RCA ostium. Once the RCA ostium is cannulated using a JL guide catheter, it provides excellent extra backup support (comparable to the support of an EBU guide catheter for the LCA) (Figure 3). Because an AL guide catheter has a higher chance of damaging or dissecting the RCA ostium, it should be used sparingly to cannulate the RCA when using the TRA. However, we recommend that inexperienced operators refrain from using this catheter (Figure 4).

It is possible to use the deep intubation technique through the TRA. Although it is an effective technique to tackle difficult distal lesions and perform thrombosuction, it should be used sparingly and only by very experienced radialists (Figure 5). When performing interventions in an anomalous RCA arising from the left coronary cusp, a JL 3 guide catheter is a good choice because it sits coaxially in the RCA ostium and provides good backup support (Figure 6.) When performing interventions in an anomalous RCA arising high and anteriorly from the ascending aorta, a 6-F multipurpose (MP-1) catheter is a good choice for coaxial cannulation and backup support (Figure 7).

CANNULATING BYPASS GRAFTS DURING TR PCI

When TRA was introduced, cannulation of a bypass graft was considered to be a relative contraindication. In contemporary practice, this is not true. Both right and left TRA are equally effective for bypass graft interventions.[6-8] JR and AR guide catheters are effective in cannulating saphenous vein grafts (SVGs) and radial artery grafts to the LCA and RCA, in most instances. A multipurpose (MP-1) catheter is useful for cannulating and maintaining coaxiality with the ostium, particularly during intervention of the SVG to the RCA. Furthermore, an AL catheter is able to cannulate the SVG to the LCA or RCA, particularly when the aortic root is significantly dilated and distorted. There is practically no difference in catheter choice for cannulating SVGs and radial grafts working through the right or left TRA. A left IMA (LIMA) graft is easy to cannulate through the left TRA using an IMA catheter. Although cannulation through the right TRA can be difficult, a technique to cannulate a LIMA graft

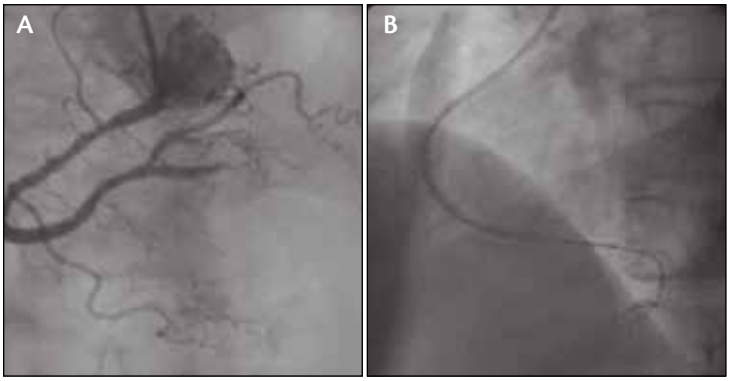

Figure 5. An RCA injection using a 6-F JR 4 guide catheter revealed a chronic total occlusion in the posterior descending artery (A). By using a deep intubation technique, the tip of the guide catheter was moved to the bifurcation of the RCA (B).

Figure 6. A 6-F JL 3 guide catheter was used to cannulate an RCA arising anomalously from the left coronary cusp. Selective RCA injection revealed the final stent result.

through the right TRA has been described.[6,9] It is important to learn this technique, because in many patients whose left radial arteries have already been harvested for use as bypass grafts, right radial access would be the only low-risk alternative. For graft interventions through the TRA, 6-F guide catheters are usually preferred, because it is possible to use practically all distal protection devices through them.

THE ROLES OF VARIOUS TYPES OF GUIDE CATHETERS

5-F Guide Catheters

Although 5-F guide catheters are being used in < 10% of interventions, it is important to understand their pros and cons. On the pro side, they allow interventions through a 5-F introducer sheath, they offer higher success rates when working through small radials and difficult loops, and they are less traumatic during deep intubation maneuvers. As far as the cons, they pose a higher risk of air embolism during percutaneous transluminal coronary angioplasty catheter removal, they provide relatively poor visualization of the coronary system compared to a 6- or 7-F guide catheter, and a 5-F guide catheter does not allow a kissing-balloon or kissing-stent technique nor the use of bulky devices (ie, rotational atherectomy, distal protection devices, etc.).

Figure 7. A 6-F multipurpose (MP-1) catheter cannulated an anomalous RCA arising high and anteriorly from the ascending aorta.

7-F Guide Catheters

For very complex interventions in which multiple devices need to be accommodated, a 7-F guide catheter is required. Fewer than 30% of radial arteries have a diameter that is sufficient to accommodate a 7-F introducer sheath and a 7-F guide catheter easily.[10] We have described an important technique of "balloon-assisted tracking" to accommodate a 7-F guide catheter through a small-caliber radial artery.[11]

Sheathless Guide Catheters

The outer diameter of a standard hydrophilic sheath is approximately 1.5- to 2-F sizes larger than the outer diameter of its corresponding guide catheter. Therefore, sheathless guide catheter insertion allows for a larger internal lumen without increasing the outer diameter size.[6,12-14] A 7-F sheathless guide catheter with almost the same outer diameter as a 5-F sheath will enable complex TR PCI to be performed in most radial arteries. A similar strategy allows for 5- and 6-F sheathless interventions that are nearly equivalent to the use of 3- and 4-F sheaths in patients with small radial arteries or for those in whom maintenance of radial patency is paramount.

Minimizing trauma upon insertion of the sheathless guide catheter into the radial artery is key to success with such an approach. A custom-made commercial guide catheter with hydrophilic coating and a long tapered central dilator are ideal for seamlessly transitioning between the wire, dilator, and guide catheter for atraumatic entry into the radial artery. However, these devices are more expensive and are not universally available. It is also possible to use standard equipment that is available in all cath labs to fashion an inner dilator for standard guide catheters.

CONCLUSION

It is important for an operator to be discriminating when choosing catheter shapes during transradial PCI. A thorough understanding of anatomical course and

relevant issues is necessary. An operator also needs to understand the behavior of a catheter during challenging situations. Although many guide catheter shapes are available, an ideal radial Judkins curve is eagerly awaited. ■

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